

Solar energy could provide a clean and almost unlimited supply of power. But solar energy is spread so thinly that large-scale use of the sun's power would require a huge land area. In addition, darkness and bad weather interrupt the supply of sunlight.

Wind Power turns windmills and propels sailboats. Airplanes use the power of a high-altitude wind called the *jet stream*. Wind itself costs nothing and creates no pollution. But wind power is practical only in areas that have strong, steady winds.

Tidal Energy can be used wherever there are high tides in a bay that can be closed by a dam. During high tide, the bay fills with water. During low tide, the level of the ocean drops below the level of water stored behind the dam. The stored water is then released. As the water falls, it drives turbines that generate electricity. The world's first tidal power plant began to operate in 1966 in France. The chief disadvantage of tidal power is that it can produce electricity only at certain times and for short periods. In addition, plants can be built in few places.

Geothermal Power is generated wherever water comes into contact with heated underground rocks and turns into steam. Power companies drill into areas where underground steam is trapped and direct it into the blades of steam turbines. In areas where underground steam does not exist naturally, engineers can create it by injecting water into hot rock. Geothermal power plants do not burn anything, and so no smoke pollutes the air. Some of these plants produce electricity more cheaply than do ordinary power plants. Several countries, including Italy, Japan, and the United States, had developed geothermal power plants by the mid-1970's.

Magnetohydrodynamic (MHD) Generators convert fuel directly into electricity. An MHD generator burns coal or other fuel at high temperatures to produce a hot *ionized* (electrified) gas. The gas shoots through a magnetic field, where it produces an electric current that is drawn off by electrodes. After the gas has passed through the MHD generator, it can drive a turbine to produce more electricity. MHD generators could provide a highly efficient power source, but many technical problems remain to be solved. In the mid-1970's, Russia had the world's only large MHD generator.

Fuel Cells are batterylike devices in which gas or liquid fuels combine chemically to generate electricity. Fuel cells in the Apollo spacecraft produced electricity from a reaction of hydrogen and oxygen. Fuel cells can produce twice as much electricity as ordinary generators can from a given amount of fuel. Nothing burns in fuel cells, so they cause little pollution and lose little energy in waste heat. But they are expensive to make.

Solid Wastes can also provide energy. Various cities throughout the world produce electric power by burning trash. Another process, called *bioconversion*, uses plant and animal wastes to produce such fuels as methanol, natural gas, and oil. For example, one bioconversion method used in the United States extracts oil from waste wood chips by means of intense heat and pressure.

Hydrogen could someday replace both gas and oil as a fuel. It burns easily, giving off huge amounts of heat and one harmless by-product, water. Chilled to liquid

form, hydrogen could flow through pipelines. It might serve as a lightweight, nonpolluting fuel for aircraft and automobiles. Hydrogen can be extracted from ocean water by running an electric current through the water. But this process, called *electrolysis*, requires enormous quantities of electricity.

History

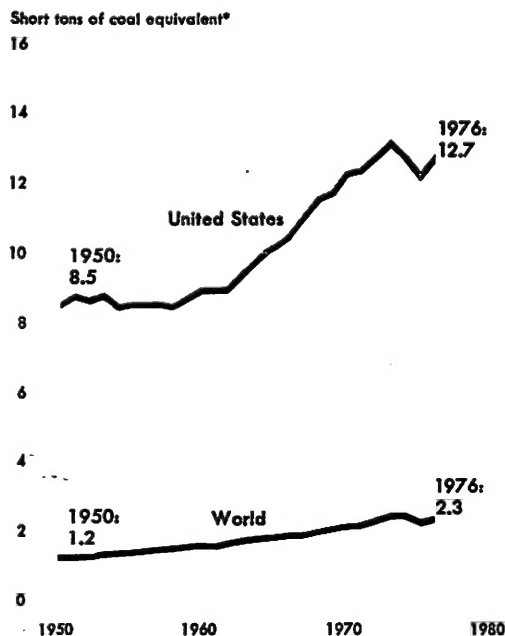
Early Days. Human beings learned to make fire about 500,000 B.C. Until then, their only source of energy had been their own strength. With the heat energy released by burning wood, people warmed themselves, cooked food, and hardened pottery. About 3200 B.C., the Egyptians invented sails and used the wind to propel their boats. Water wheels, developed in ancient times, harnessed the power of falling water.

Until the late 1700's, wood ranked as the most important fuel. People used so much timber that it began to grow scarce, and coal gradually took its place. The growing demand for coal brought a search for better mining methods, including ways to keep mine shafts from flooding. In 1698, an English inventor named Thomas Savery patented an improved pump to drain mines. Savery's pump was powered by the first practical steam engine. People now had a device that could change heat into mechanical energy to do work.

The Industrial Revolution. The steam engine became the chief source of power for industry and transporta-

Energy Use Per Person

The graph below shows how the level of energy use per person has risen since 1950. Energy consumption per person is nearly six times as high in the United States as in the entire world.



Source: Statistical Yearbooks, 1980-1977, United Nations.